REMARKS

This is intended as a full and complete response to the Final Office Action dated January 2, 2004, having a shortened statutory period for response set to expire on April 2, 2004. Claims 1-33 are shown above. Among them, claims 1-18, 26-31, and 33 remain pending in the application and are shown above.

Applicants have amended claims 1, 12, 16, and 26. In addition, Applicants have canceled claims 4, 15, and 28. The amendments to claims 1, 12, and 26 include the limitations of canceled claims 4, 15, and 28, respectively. Applicants assert that no new matter is being submitted in amended claims 1, 12, and 26. Applicants reserve the right to pursue the subject matters of original claims 1, 12, and 26 at a later date. Claim 16 is amended to correct formality. Please reconsider the claims pending in the application for reasons discussed below.

35 U.S.C. §103 Rejections

Claims 1-3, 8, 12-14, 16, 26, 27 and 33 are patentable over *Small* in view of *Svirchevski et al.* under 35 U.S.C. §103(a)

Claims 1-3, 8, 12-14, 16, 26, 27 and 33 stand rejected under 35 USC § 103(a) as being obvious over United States Patent No. 5,981,454 to *Small* and United States Patent No. 6,352,595 to *Svirchevski et al.* Applicant respectfully traverses the rejection. *Small* discloses a method of rinsing or polishing a wafer using a post clean treatment composition. *Svirchevski et al.* discloses a method of cleaning a polishing pad using a composition of hydrogen chloride (HCl) and water when the wafer surface is copper, or ammonium hydroxide (NH4OH) and water, when the wafer surface is oxide. *Svirchevski et al.* does not teach, show, or suggest a composition including about 0.1 to about 3.0 wt.% of at least one organic compound containing one or more amine or amide groups and an acid or a base in an amount such that the composition has pH of about 8 to about 11, as claimed in claims 1, 12, 26, and claims dependent therefrom.

With regard to the Examiner's comments that in *Small* "the explicitly disclosed range of the amine is 3-20%" and "Figure 3 appears to contemplate a range of activity below 3%" on the disclosed amine range of Figure 3, Applicants respectfully point out that the cited Figure 3 of *Small* is not directed to the post clean treatment composition of *Small* as the Examiner stated. The disclosed range of amine is not related to the amine concentration of the post clean treatment composition of *Small*. Figure 3 of *Small* is directed to a testing of corrosion rate of aluminum (Al) metal, on a wafer surface as a function of amine concentrations (from 0% to 100%) when rinsing the post clean wafer with a solution containing 0% to about 100% of amine. Thus, Figure 3 is to demonstrate the problem of using just amine as rinsing agent and clearly shows that very small quantities of amines will be very corrosive to the (aluminum) metal. (See, column 3, lines 53-60, column 4, lines 7-10, and Figure 3.) The illustration of Figure 3 is not part of the post clean treatment composition of *Small*, rather than a showing of a problem existed during cleaning in an etch process. Because of the damaging effect of amine to the wafer as presented in Figure 3 of *Small*, *Small* thus proposes the use of an organic acid in the presence of a buffering amount of hydroxylamine as a post clean treatment composition to neutralize amine in any previous solution, which is left on the wafer surface, into pH 7. (See, column 3, lines 54-62.) Therefore, *Small* discloses a post clean treatment composition including about 1% to about 25% by weight of an organic acid and a buffering amount of hydroxylamine to a final pH of between about 3.5 and about 7. (See, columns 14-16.) In contrast to the Examiner's statement, it is not clear what is the percentage of hydroxylamine used by *Small* with regard to the buffering amount of hydroxylamine. Thus, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest about 0.1 to about 3.0 wt.% of at least one organic compound containing one or more amine or amide groups, as claimed in claims 1, 12, 26, and claims dependent therefrom.

Small discloses a method of rinsing a wafer with a post clean treatment composition to rinse and remove chemical residues from a wafer having metal or dielectric surfaces after a wet chemistry step, such as post etch residue cleaning step. (*See*, column 1, lines 29-37 and 45-52.) The post clean treatment composition of *Small* is for rinsing a wafer in which it is important that the pH is neutral (*i.e.*, pH of 7) after the

wafer has been cleaned by a cleaning solution of a very basic pH (*e.g.*, pH >10) in any previous cleaning step. The Examiner erred in stating a background problem illustration of Figure 3 as part of the post clean treatment composition of *Small.* (*See*, column 3, lines 54-67 and column 4, lines 1-17.) Figure 3 is included only to show the undesirability of using amines on aluminum. Thus, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest a composition having a pH of about 8 to about 11, as claimed in claims 1, 12, 26, and claims dependent therefrom.

Further, the treatment composition of *Small* is used to rinse the wafer into a neutral pH in a bath or a beaker (container) containing the post clean treatment solution (PCT), *e.g.*, step 22 in Figure 2. The immersion duration disclosed in *Small* is from 20 minutes (Examples 7-8) or 30 minutes (Example 2) to 24 hours (Example 3), which is in very different time frame than in seconds. In addition, there is no motivation to combine *Small* 's composition with *Svirchevski et al.* in the range of seconds and there is no suggestion that such combination will work. Thus, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest applying the solution to the polishing pad for about 3 seconds to about 20 seconds, as claimed in claims 7, 18, and 30.

Still further, the rinsing step 22 of *Small* employs the post clean treatment solution of *Small* in place of a carbonated water rinse step 16, an isopropyl alcohol rinse step 18, or an N-methyl pyrrolidone rinse step 20, in a typical etch process sequence after a cleaning step of an ashing step 12 or a wet chemistry step 14 to clean photoresist or etch residues. (*See*, column 3, lines 40-51, and Figure 2.) Noted that the etch process disclosed in *Small* is a very different process than a chemical mechanical planarization (CMP) process and the post etch cleaning process of *Small* does not involve a polishing pad ever, not to mention cleaning a polishing pad. Thus, the post clean treatment composition of *Small* is for rinsing the wafer in the absence of a polishing pad. *Small* does not teach, show, suggest, or motivate applying the post clean treatment composition of *Small* for cleaning a polishing pad subsequent to chemical mechanical polishing (CMP) a wafer surface containing copper (Cu) or a Cu-based alloy. Therefore, *Small* does not teach, show, or suggest the method of cleaning a polishing pad, as claimed in claims 1, 12, 26, and claims dependent therefrom. In addition, *Small* does not teach, show, or suggest applying to the polishing pad surface a cleaning

composition in the absence of a wafer, as claimed in claims 1, 12, 26, and claims dependent therefrom. Giving the very different processes of *Small* and *Svirchevski et al.*, and there is no motivation to combine the teachings, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest the cleaning composition or the method as claimed in claims 1, 12, 26, and claims dependent therefrom

In addition, *Small* discloses that the post clean treatment composition can also be used as a rinsing solution for a wafer in a very different process, a chemical mechanical planarization (CMP) process after a final cleaning step (post CMP clean) for cleaning a wafer, such as after brush scrubbing a post-CMP wafer and a rinse, to further rinse and clean the post-CMP wafer. (See, column 4, lines 35-44.) The post CMP clean process of *Small* is for the post-CMP wafer being immersed in a bath/container for 60 minutes (Example 5) to about 24 hours (Example 3), not loaded on a CMP platen, and definitely in the absence of a polishing pad. (*See*, Examples 3-5.) Thus, *Small* does not teach, show, or suggest applying the solution to the polishing pad for about 3 seconds to about 20 seconds, as claimed in claims 7, 18, and 30. The pH of the post clean treatment solution for this rinsing step after a post-CMP cleaning step is in the acidic range and *Small* described that " hydroxylamine in the acidic solution is a mild oxidizing agent' and Table V and VII show "the effect of rinses composed of organic acids and buffered with either hydroxylamine or ammonium hydroxide to a final pH of 4.5. (*See*, column 4, lines 35-44, column 5, lines 15-17, column 6, lines 1-7 and lines 38-41.) In addition, there is no motivation to combine the teachings to use *Small*'s composition for a wafer immersed in a container after CMP with *Svirchevski et al.*'s method for a polishing pad loaded on a CMP platen. Thus, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest the cleaning composition as claimed or a method of cleaning a polishing pad by applying to the polishing pad surface the cleaning composition in the absence of a wafer and at a pH of about 8 to about 11, as claimed in claims 1, 12, 26, and claims dependent therefrom.

The third use of the post clean treatment composition of *Small* is directed to a polishing step of silicon oxide CMP or metal CMP as a polishing slurry, by applying the post clean treatment composition on a wafer to polish the wafer in the presence of a polishing pad, and in both case, *Small* discloses that the pH is very important. (*See*,

column 5, lines 15-17, column 6, lines 1-7 and lines 38-41.) *Small* further discloses that "copper films present a difficult problem because it is a soft metal and is easily damaged by the slurry particles". Noted that a typical CMP process involves complex interaction among at least three components including a wafer, a polishing pad, and a polishing slurry in order to planarize the surface of the wafer. In contrast, cleaning a polishing pad after the polishing pad has been through a CMP process involves the interaction between a polishing pad and a cleaning solution. In addition, there is no motivation to combine the teachings to use *Small*'s slurry composition for polishing a wafer in the presence of a polishing pad during CMP with *Svirchevski et al.*'s method of cleaning a polishing pad loaded on a CMP platen in the absence of a wafer and after the polishing pad has been used to polish a wafer. Again, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest the cleaning composition as claimed or a method of cleaning a polishing pad subsequent to chemical mechanical polishing (CMP) a wafer surface containing copper (Cu) or a Cu-based alloy by applying to the polishing pad surface the cleaning composition in the absence of a wafer and at a pH of about 8 to about 11, as claimed in claims 1, 12, 26, and claims dependent therefrom.

Further, with regard to the pH range, the acidic pH range of about 3.5 to 7 of the post clean treatment composition of *Small* is provided to neutralize the pH of a wafer until the pH reaches 7 and prevent corrosion of metal structure on a wafer during rinsing. *Small* does not teach, show, or suggest a cleaning composition at a pH range of about 8 to about 11 for a polishing pad surface, as recited in claims 1, 12, 26, and claims dependent therefrom. *Small* teaches a composition for different processes than claimed, *i.e.*, rinsing a wafer or polishing a wafer using the post clean treatment composition, rather than cleaning a polishing pad surface that has been used and left with copper residues after CMP. Due to the obvious different materials of a wafer and a polishing pad and the complexity of chemical reactions involved in various different processes, *e.g.*, post etch wafer cleaning, wafer polishing by CMP, post CMP wafer cleaning, as compared to the claimed post CMP and between CMP pad cleaning, comparing the pH range of one composition suitable for a first material in a first process with the pH range of another composition to be used for a second material in a second process is not appropriate. Therefore, the references, alone or in combination, do not teach, show, or

suggest the method and composition, as recited in claim 1, 12, 26, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 12-14 and 16 are not obvious over *Small* in view of *Svirchevski et al.* under 35 U.S.C. §103(a)

Claims 12-14 and 16 stand rejected under 35 USC § 103(a) as being obvious over *Small* as set forth above and United States Patent No. 6,352,595 to *Svirchevski et al.* Applicant respectfully traverses the rejection.

Small and *Svirchevski et al.* have been discussed above.

Small does not teach, show, or suggest the claimed composition in the claimed range for the claimed method. In addition, since *Small* does not teach, show, or suggest cleaning a polishing pad between polishing a first and a second wafers, the advantage of the post clean treatment composition of *Small* as a rinsing composition for a wafer to be useful in eliminating the need for flammable solvents, lowering ....., as disclosed by the Examiner and in *Small*, does not provide motivation or rationale for cleaning a polishing pad between polishing a first and a second wafers. Therefore, *Small* in view of *Svirchevski et al.* does not teach, show, or suggest the cleaning composition as claimed or a method of cleaning a polishing pad by applying to the polishing pad surface the cleaning composition at a pH of about 8 to about 11, after conducting CMP on a first wafer and removing the first wafer from the polishing pad, and before conducting CMP on a second wafer, as claimed in claims 1, 12, 26, and claims dependent therefrom. Withdrawal of the rejection is respectfully requested.

Claims 4-7, 9-11, and 28-31 are patentable over *Small* in view of *Kennedy et al.* under 35 U.S.C. §103(a)

Claims 4-7, 9-11, and 28-31 stand rejected under 35 USC § 103(a) as being obvious over *Small* and United States Patent No. 6,280,299 to *Kennedy et al.* Applicant respectfully traverses the rejection.

Applicants have canceled claims 4 and 28 and the amendments to claims 1 and 26 include the limitations of canceled claims 4 and 28, respectively.

Small is discussed above. *Small* does not teach, show, or suggest the method and composition as claimed.

Kennedy et al. discloses methods and apparatus of cleaning a polishing pad surface or a substrate surface. The Examiner states that *Small* apparently fails to explicitly disclose applying the solution to a rotating polishing pad at a flow rate of about 10 to 600 ml/min, and *Kennedy et al.* discloses using a flow rate between 230 and 6000 ml/min. The Examiner also states that an artisan would have been motivated by *Kennedy et al.* to optimize pad cleaning flow rates and pressures for performing the same task, in the same way, and for the same reason, and the duration of the flow would be a matter of routine optimization.

Kennedy et al. does not teach, show, or suggest the composition as claimed in claims 1 and 26, and claims dependent therefrom. Applicants respectfully point out that giving the fact that *Kennedy et al.* provides a flow rate for a method of cleaning a polishing pad, there is still no motivation existed to combine the wafer cleaning composition of *Small* with polishing pad cleaning method of *Kennedy et al.*

Further, the post clean treatment composition of *Small* works by rinsing a wafer in a bath such as immersing the wafer for a duration of 20 min (Examples 6-7) to 24 hours (Example 3) rather than for cleaning a polishing pad surface for a short time period (in seconds) after CMP. Thus, *Small* does not teach, show, or suggest applying a solution to a polishing pad for about 3 seconds to about 20 seconds after conducting CMP as recited in claims 7, 18, and 30, and can not be served as basis to be combined with *Kennedy et al.*

In addition to the above discussion of the acidic to neutral pH range of 3.5 to 7 of the post clean treatment composition of *Small* and the Examiner's error in citing Figure 3 of *Small* with regard to the concentration of amine, Applicants respectfully point out that a pH range of about 8 to about 11 is basic, and pH of about 7 is neutral. Applicants also point out that Small have clearly emphasized the importance of pH for the post

clean treatment composition to work and, in contrast to the Examiner's statement, a neutral pH of 7 does not suggest a basic pH of about 8.

Therefore, the references, alone or in combination, do not teach, show, or suggest the method as recited in claims 5-7, 9-11, and 29-31. Withdrawal of the rejection is respectfully requested.

Claims 15, 17, and 18 are patentable over *Small* in view of *Svirchevski et al.* and *Kennedy et al.* under 35 U.S.C. §103(a)

Claims 15, 17, and 18 stand rejected under 35 U.S.C. 103(a) as being obvious over *Small*, *Svirchevski et al.*, and *Kennedy et al.* as set forth above. Applicant respectfully traverses the rejection.

Applicants have canceled claim 15 and the amendments to claim 12 include the limitations of canceled claim 15.

Small, *Svirchevski et al.*, and *Kennedy et al.* have been discussed above. *Small* does not teach, show, or suggest the method and composition as claimed and *Svirchevski et al.* and *Kennedy et al.* do not teach, show, or suggest the composition as claimed. As discussed above, there is no motivation in the references to combine *Small*'s wafer cleaning composition with *Svirchevski et al.* and *Kennedy et al.*'s polishing pad cleaning method despite the disclosure of flow rates in the method of *Svirchevski et al.* and *Kennedy et al.* Therefore, the references, alone or in combination, do not teach, show, or suggest the method as recited in claims 17 and 18. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,

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